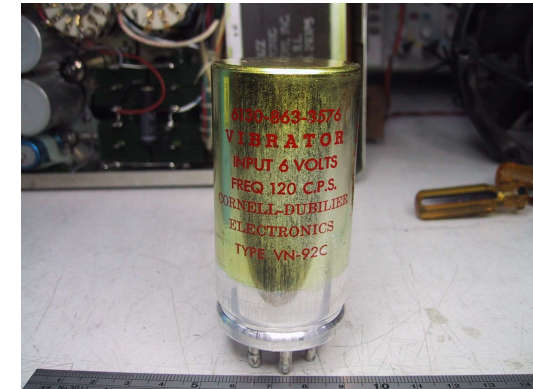
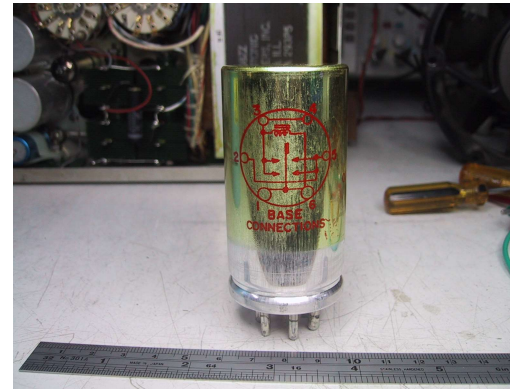
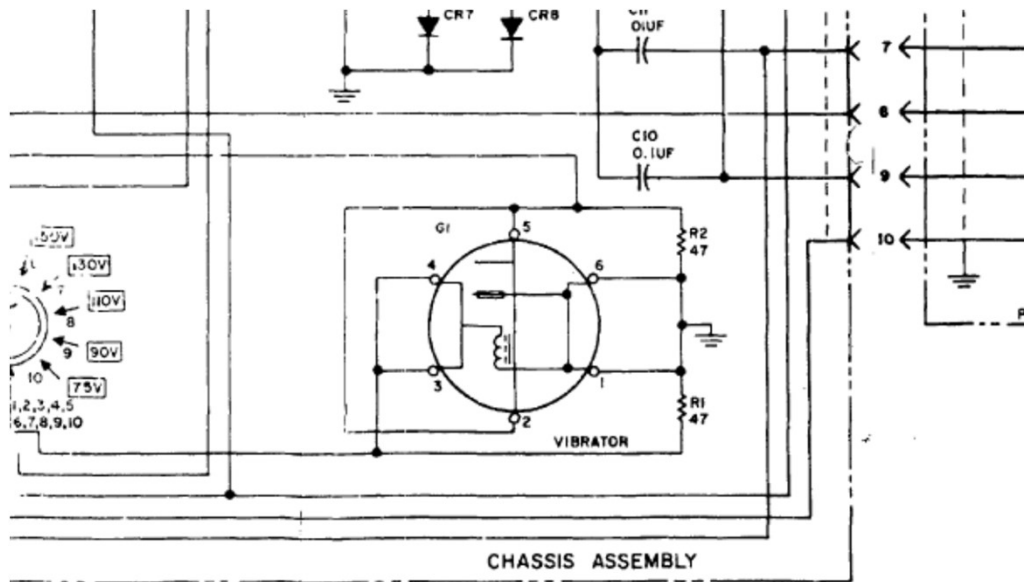


Service Log AN/GRC-109 communication system  
PP2684/GRC109 rebuild  
26-Dec-2019, Virgil Cheng vr2xgm

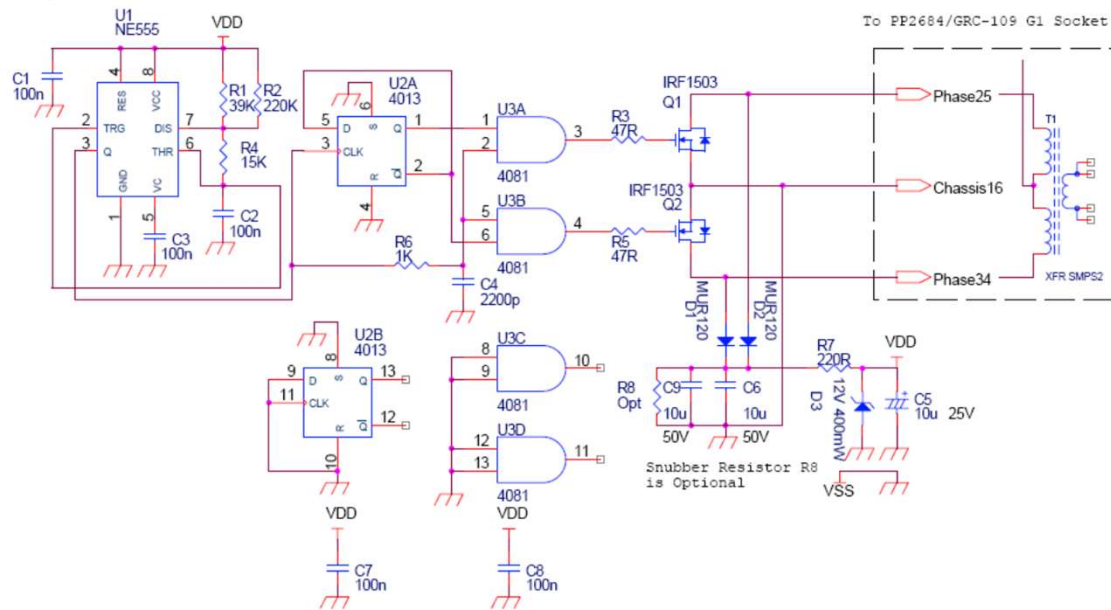
Power section service history:

- Vibrator G1 had contact problem, was replaced with a home built electronic unit back in 11-Nov-2005

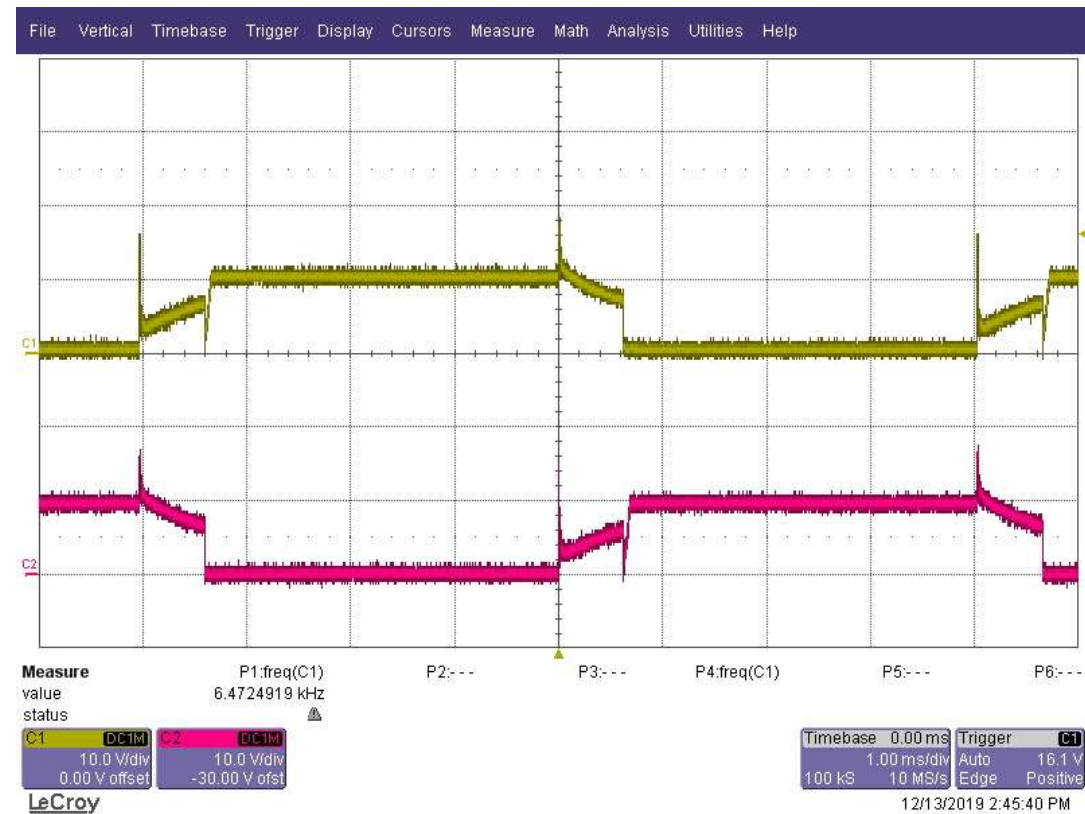
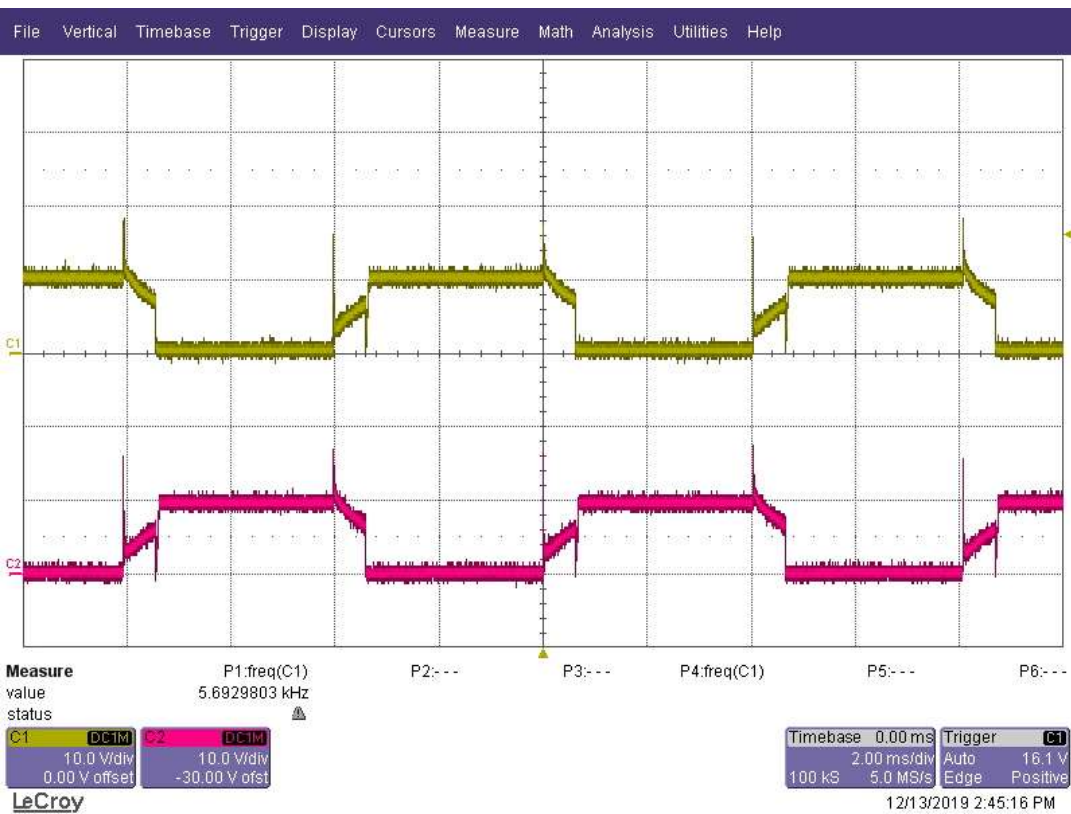


This VN-92C by Cornell-Dubilier was difficult to find, it was rebuilt with a solid-state replacement

Adjust R1//R2,R4 for 240Hz output  
Adjust R4 for ~1mS deadtime

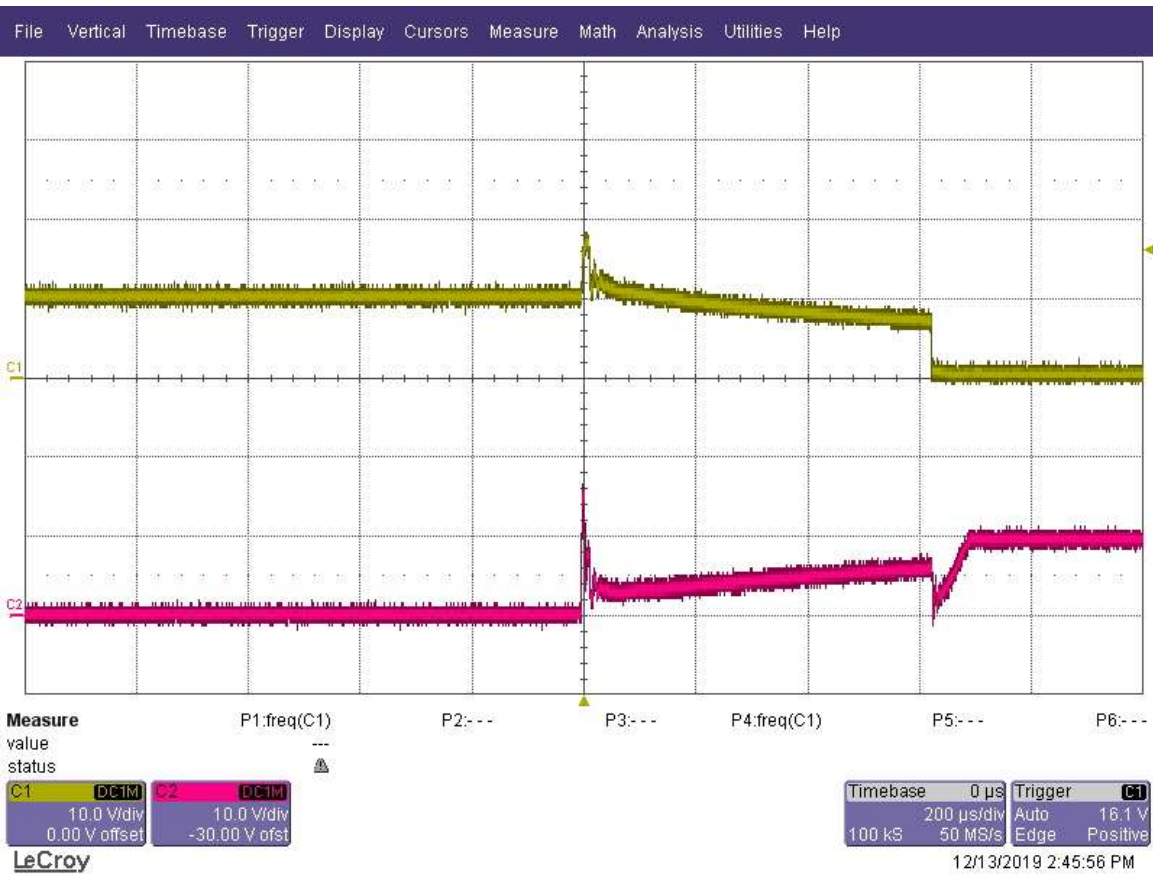


- U1 generates a 240Hz pulse with a 1mS logic '0' pulse width
- 1mS pulse doubles as deadtime for push-pull converter
- signal is fed to U2A to generate 120Hz switching frequency to match VN-92C frequency specification
- Output from U3A/B drives push-pull switched Q1 and Q2, are 30V 3.3mΩ MOSFETs
- D1/D2/R7/D3/C5 provide higher optimum circuit operating voltage once the push-pull section started up

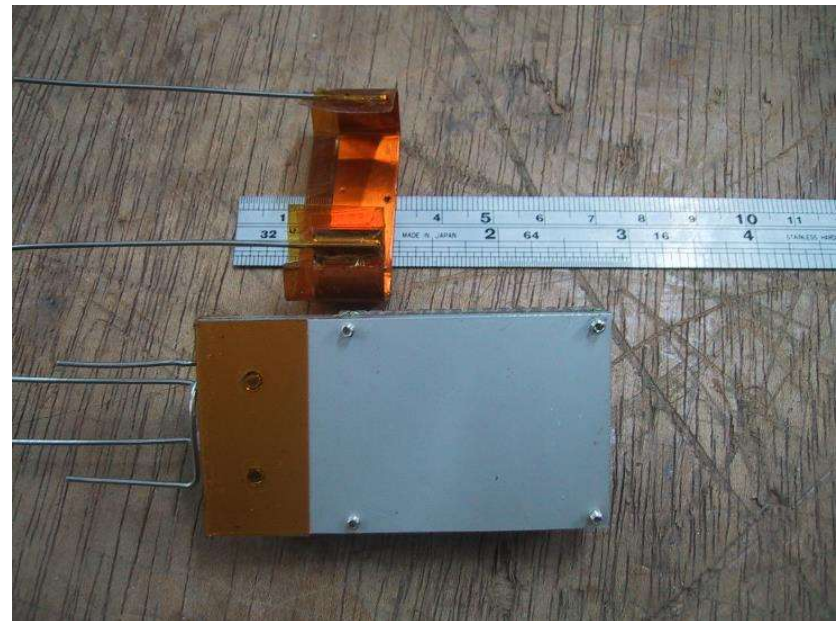
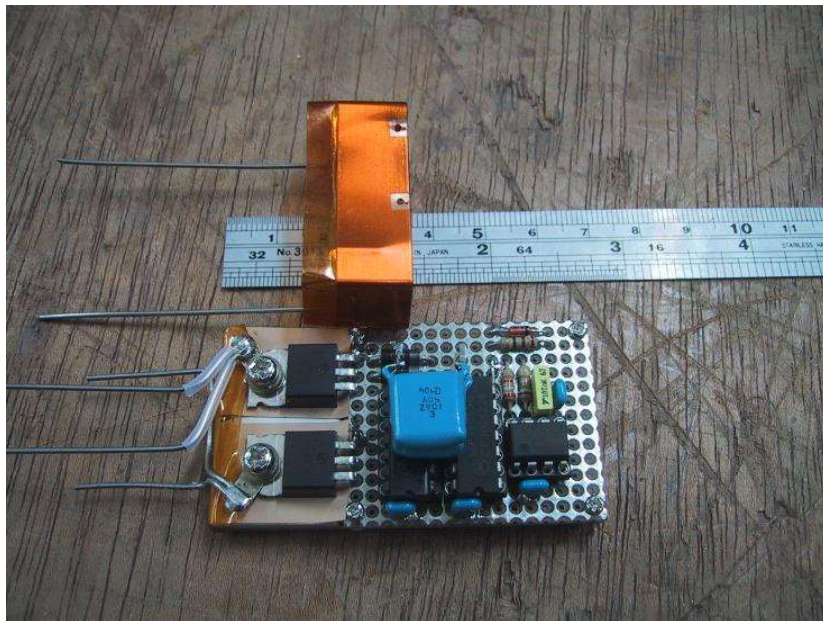
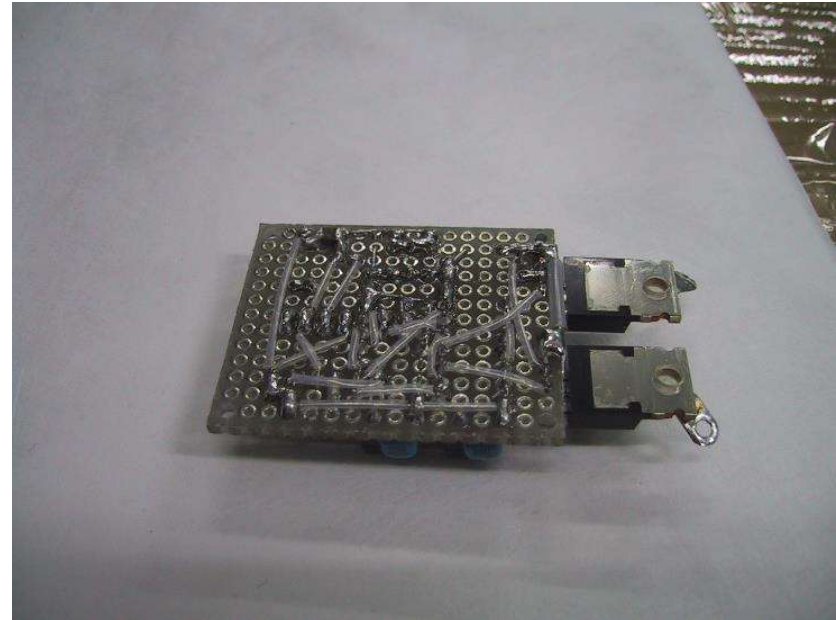
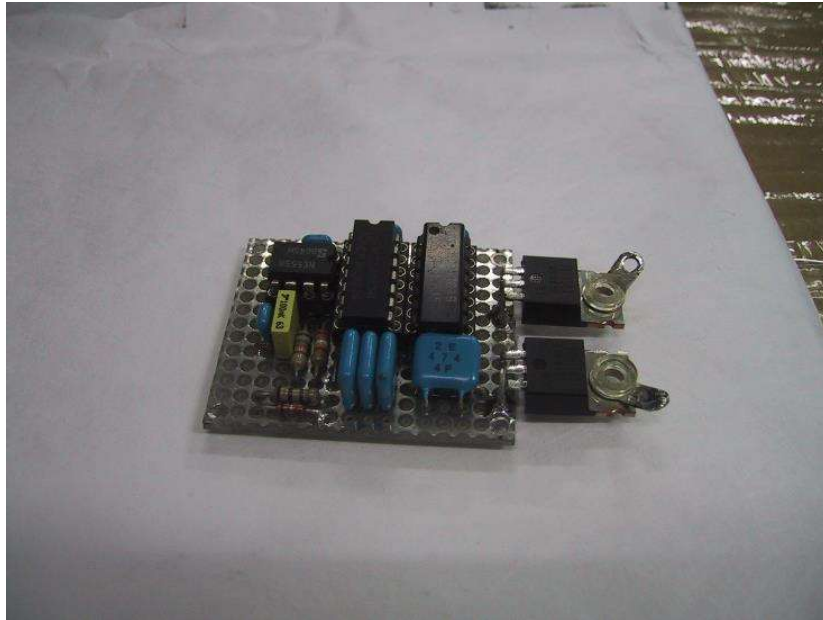


MOSFET Vds waveform, full load condition, added 13-Dec-2019

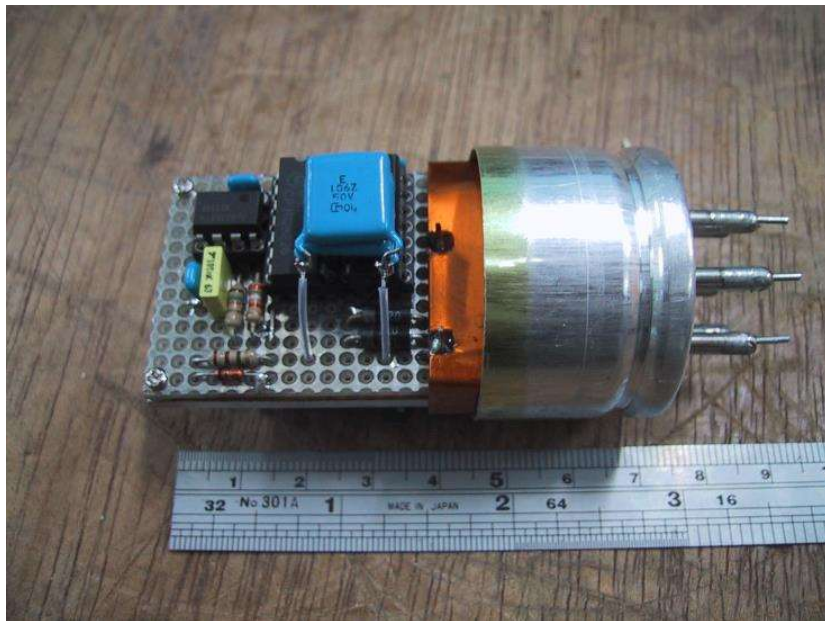
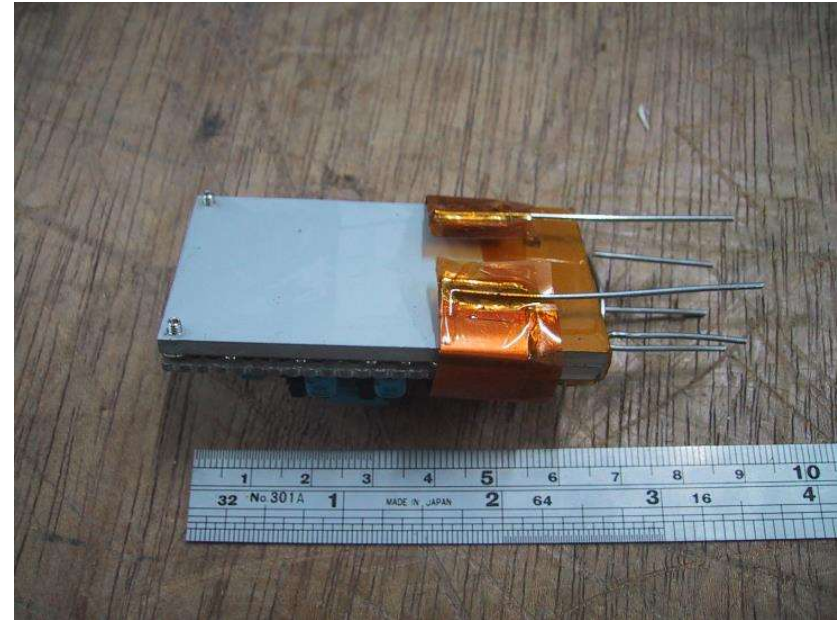
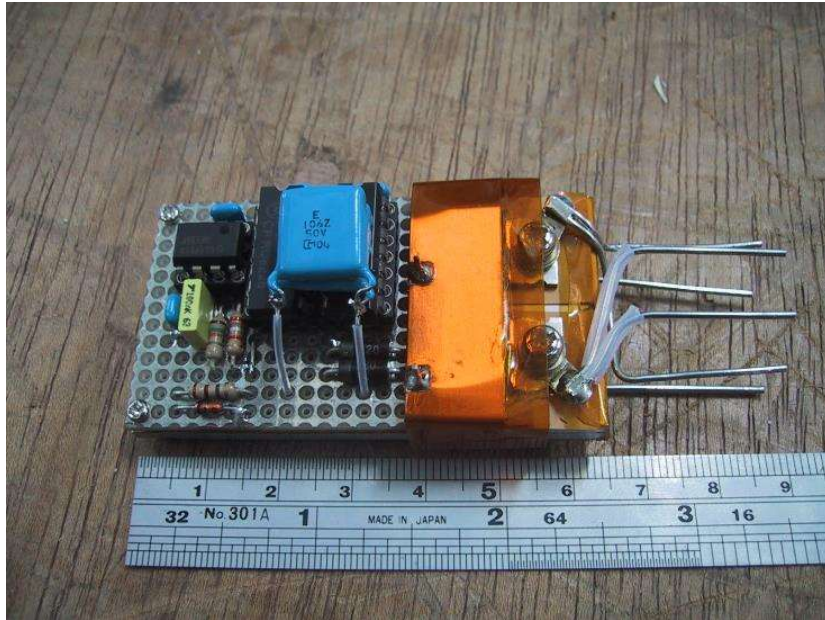




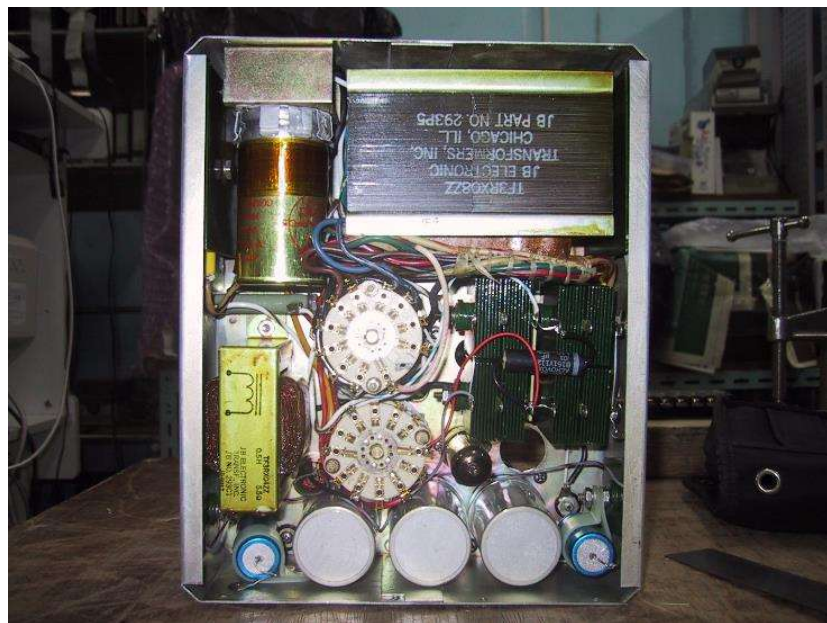
MOSFET Vds waveform, full load condition, spike closeup







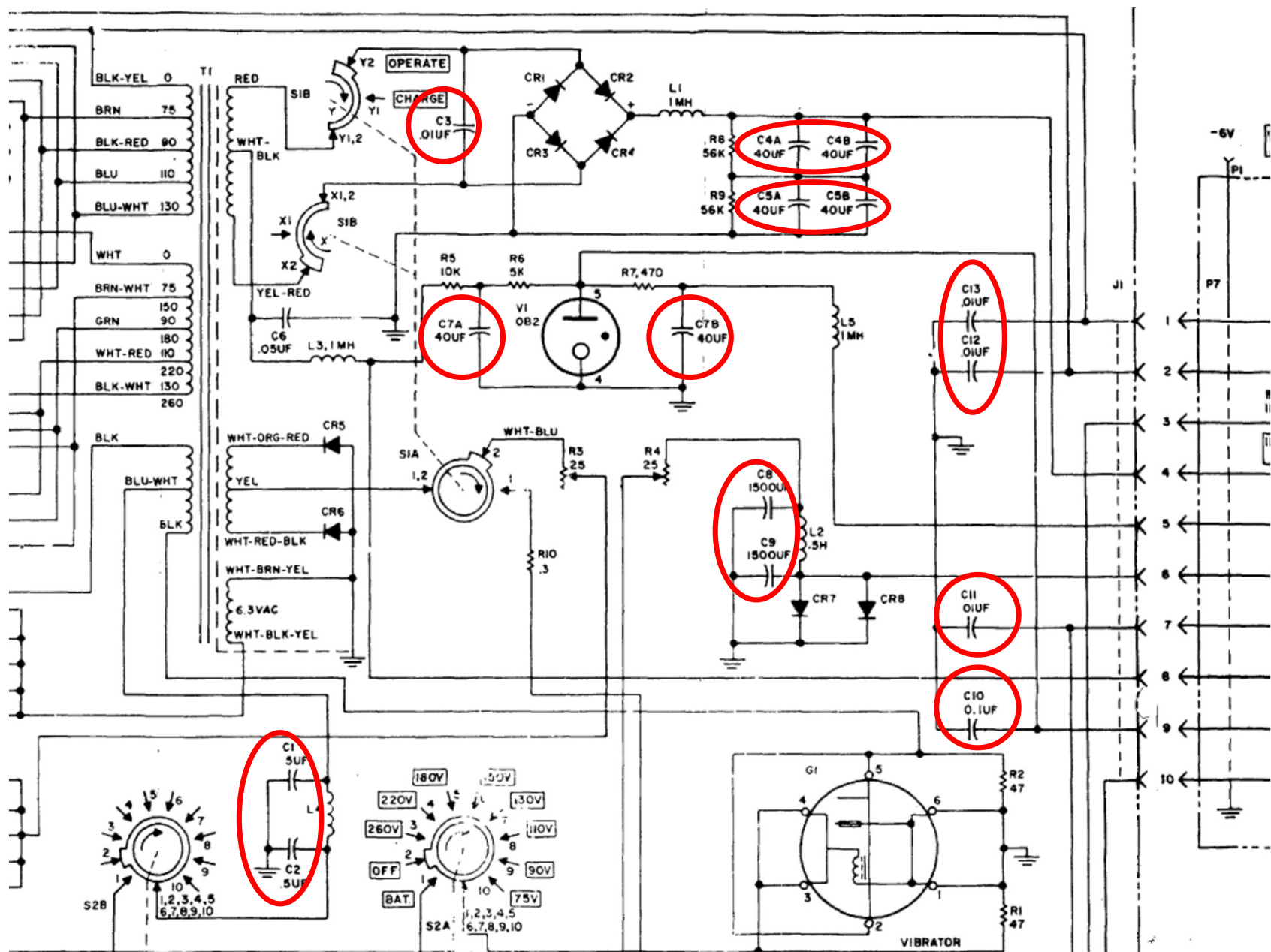




Dec-2019, Degraded components replaced

| Legend    | Description   | Replaced with                                    | Use at   |
|-----------|---|--|--|
| C1,C2     | Capacitors, film 0.5uF, 100V, Sprague Yellow Jacket | 0.47uF, 630V, PP, Panasonic ECWFE                | Vibrator push-pull circuit input filter                              |
| C3        | Capacitor, film 0.01uF, 1600V, Aerovox VBC-27       |  | High voltage winding termination capacitor                           |
| C4AB,C5AB | Capacitor, Elec, 40uF, 350V, 85°C dual              | 47uF, 400V, 105°C, Panasonic EE-A series, refill | High voltage smoothing filter, transmitter                           |
| C6        | Capacitor, film, 0.05uF, 400V, Actual 0.47uF        | 0.47uF,PP, 630V, Panasonic ECWFE                 | High voltage filter, receiver  |
| C7AB      | Capacitor, Elec, 40uF, 350V, 85°C dual              | 47uF, 400V, 105°C, Panasonic EE-A series, refill | High voltage smoothing filter, receiver                              |
| C8,C9     | Capacitor, Elec, 1500uF, 6V, 85°C                   | 1500uF, 16V, 105°C, Panasonic FR-A series        | Filament voltage decoupling  |
| C10       | Capacitor, film, 0.1uF. 400V, Aerovox V146XR        | 0.1uF, 630V, PP, Panasonic ECWFE                 | V1 voltage stabilizer hand crank generator decoupling                |
| C11       | Capacitor, film, 0.01uF, 400V, Aerovox V146XR       | 0.01uF, 630V, PP, EPCOS B32621                   | Transmitter 6V filament power decoupling                             |
| C12,C13   | Capacitor, film, 0.01uF, 400V, Aerovox V146XR       | 0.01uF, 250VAC, PP, Y2, Iskra KNB2520 MKP        | AC power line Y capacitors, upgraded with safety approved capacitors |
| C14       |   | Not replaced                                     |  |





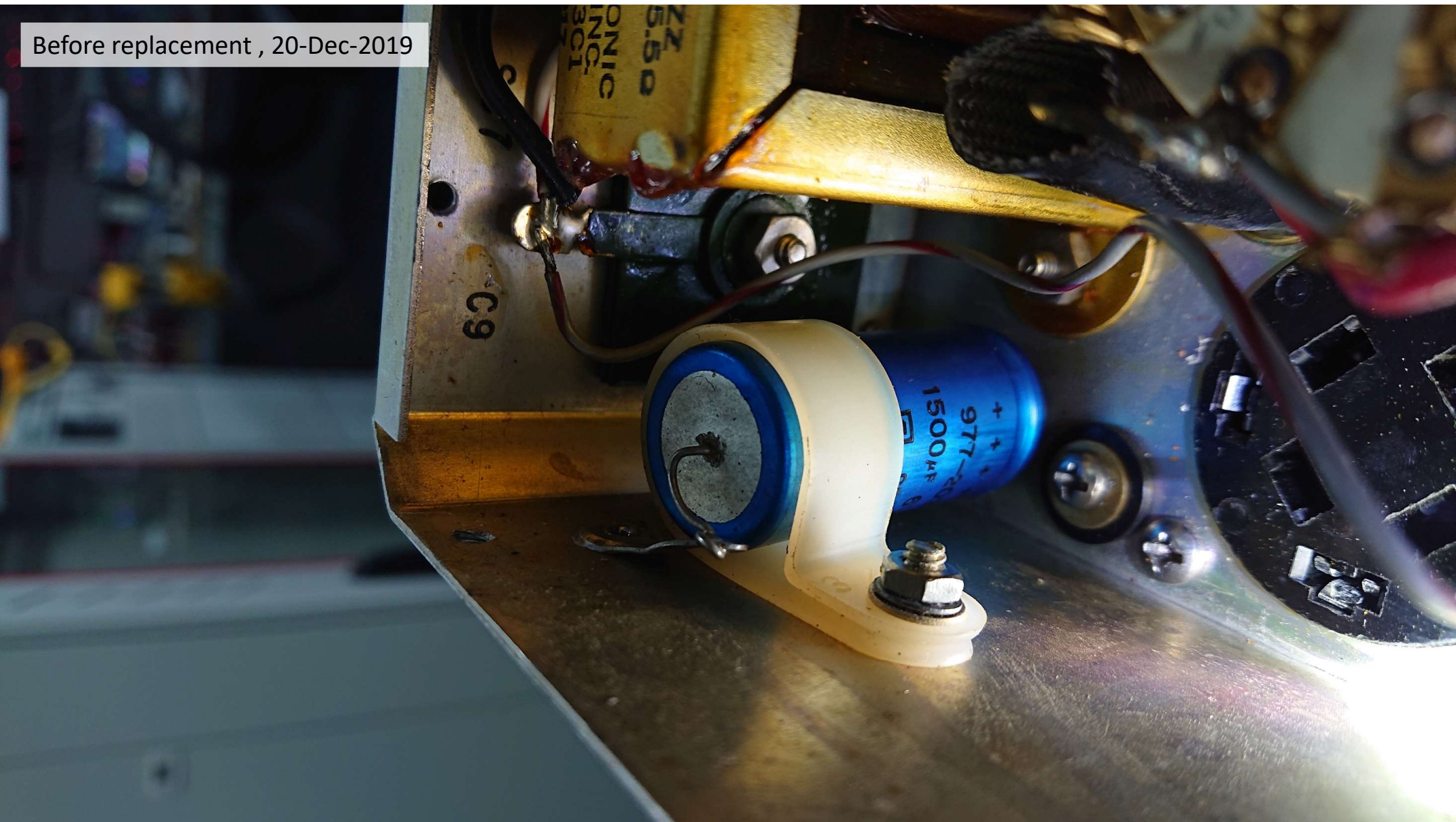


Before replacement with C4,C5,C7 unplugged, 20-Dec-2019

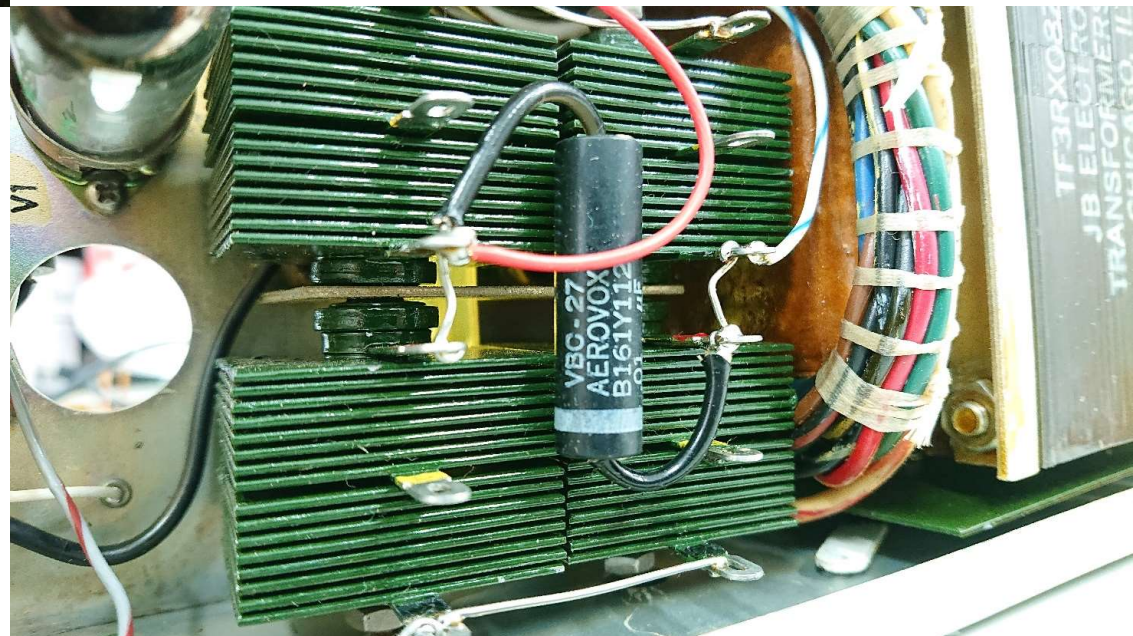
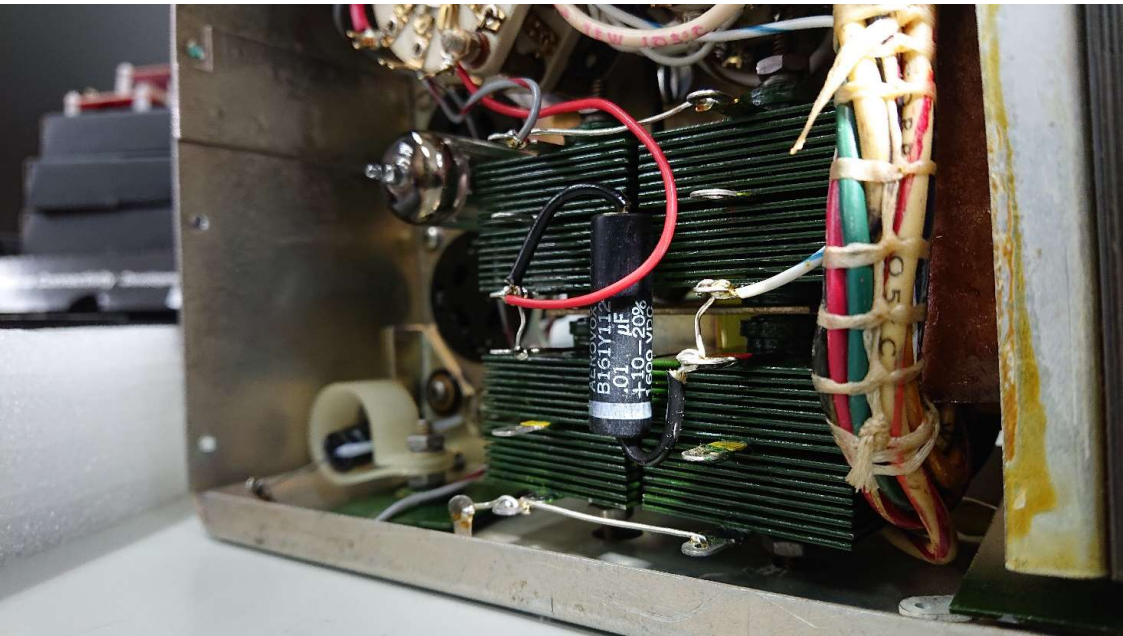




Before replacement , 20-Dec-2019









Before replacement C4,C5,C7 unplugged, 20-Dec-2019



The image shows three cylindrical capacitors, likely electrolytic, with metal terminals. The capacitors are silver-colored and show signs of aging and corrosion. The top terminals are unplugged, and the internal brownish liquid is visible. The capacitors are labeled with 'C4', 'C5', and 'C7' in red ink. The left capacitor has 'C4' and '240680' visible. The middle capacitor has 'C5' and '240680' visible. The right capacitor has 'C7' and '240680' visible. The capacitors are sitting on a light-colored surface.

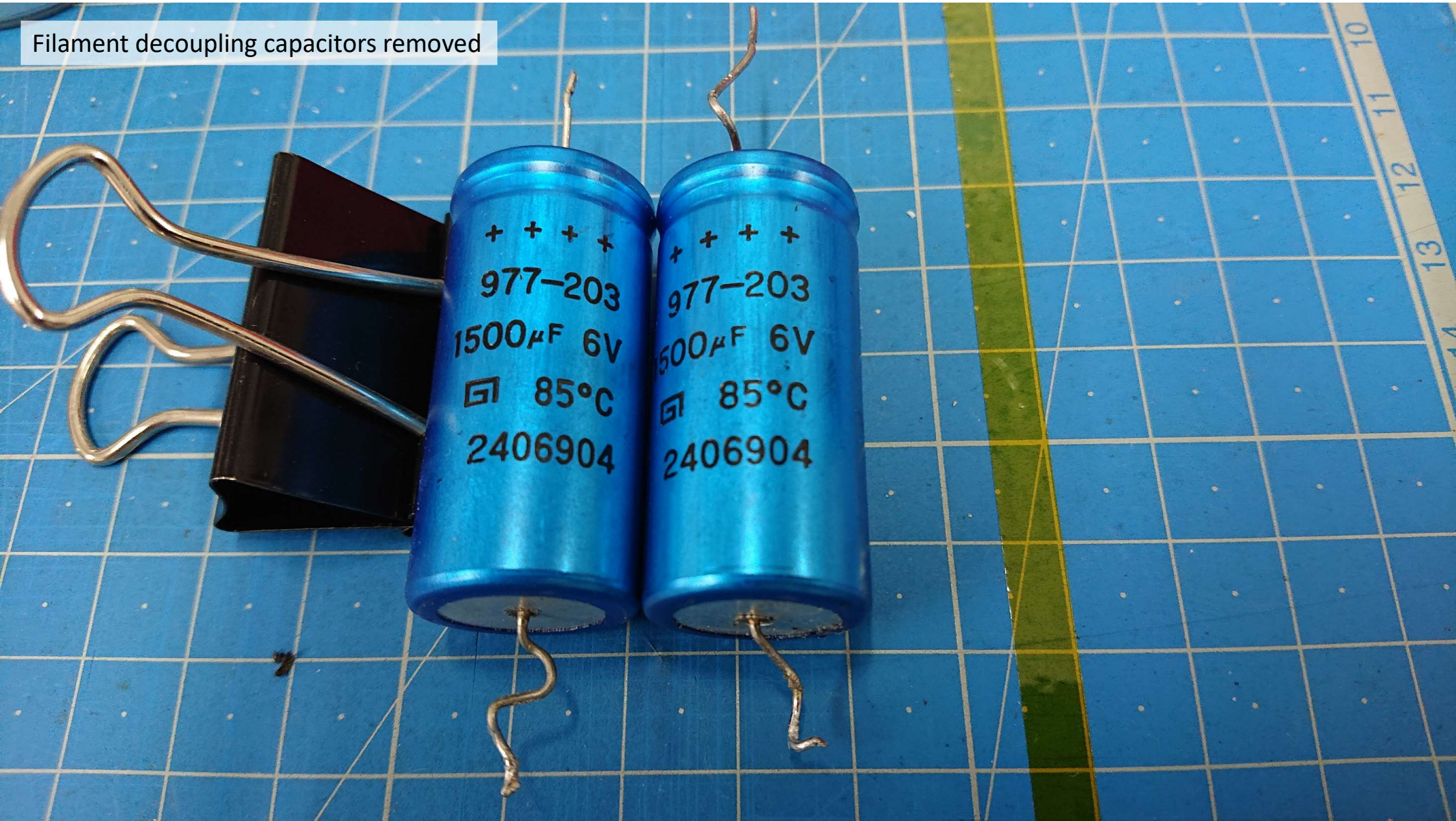


40uF 350V x2 capacitor opened



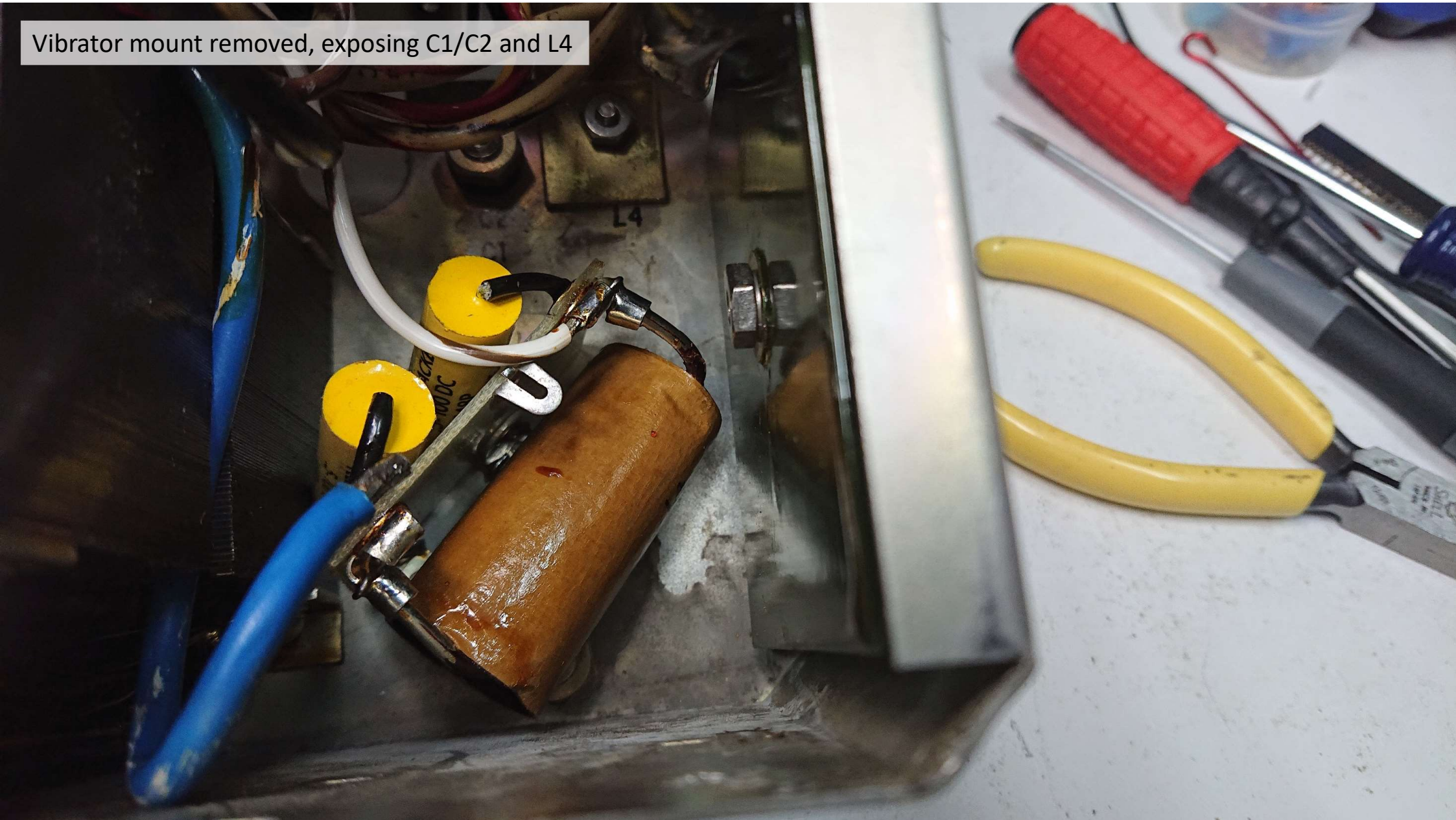


Filament decoupling capacitors removed





Vibrator mount removed, exposing C1/C2 and L4



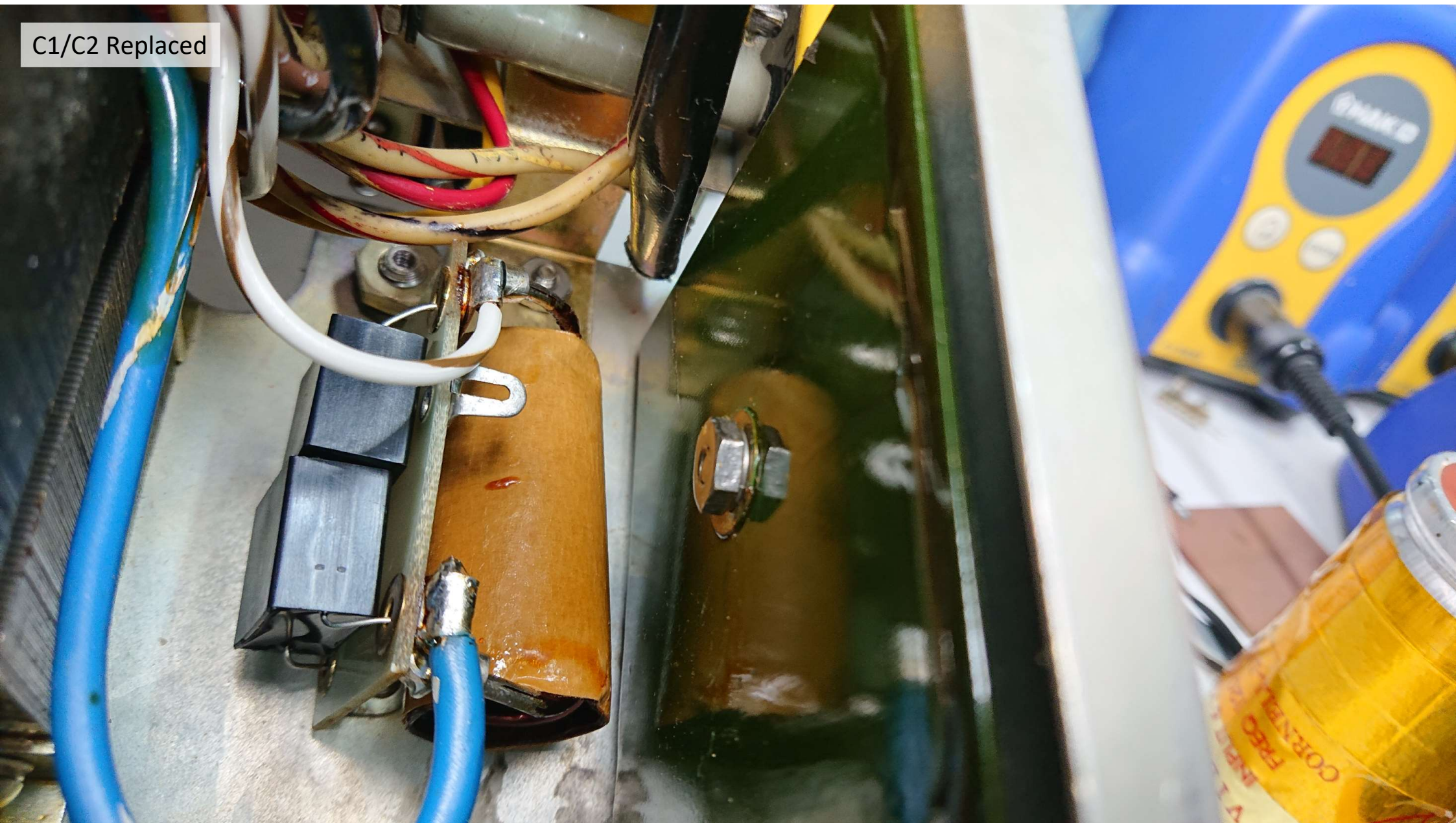


C1/C2 and L4 removed from chassis, L4 measured 3uH at 100KHz



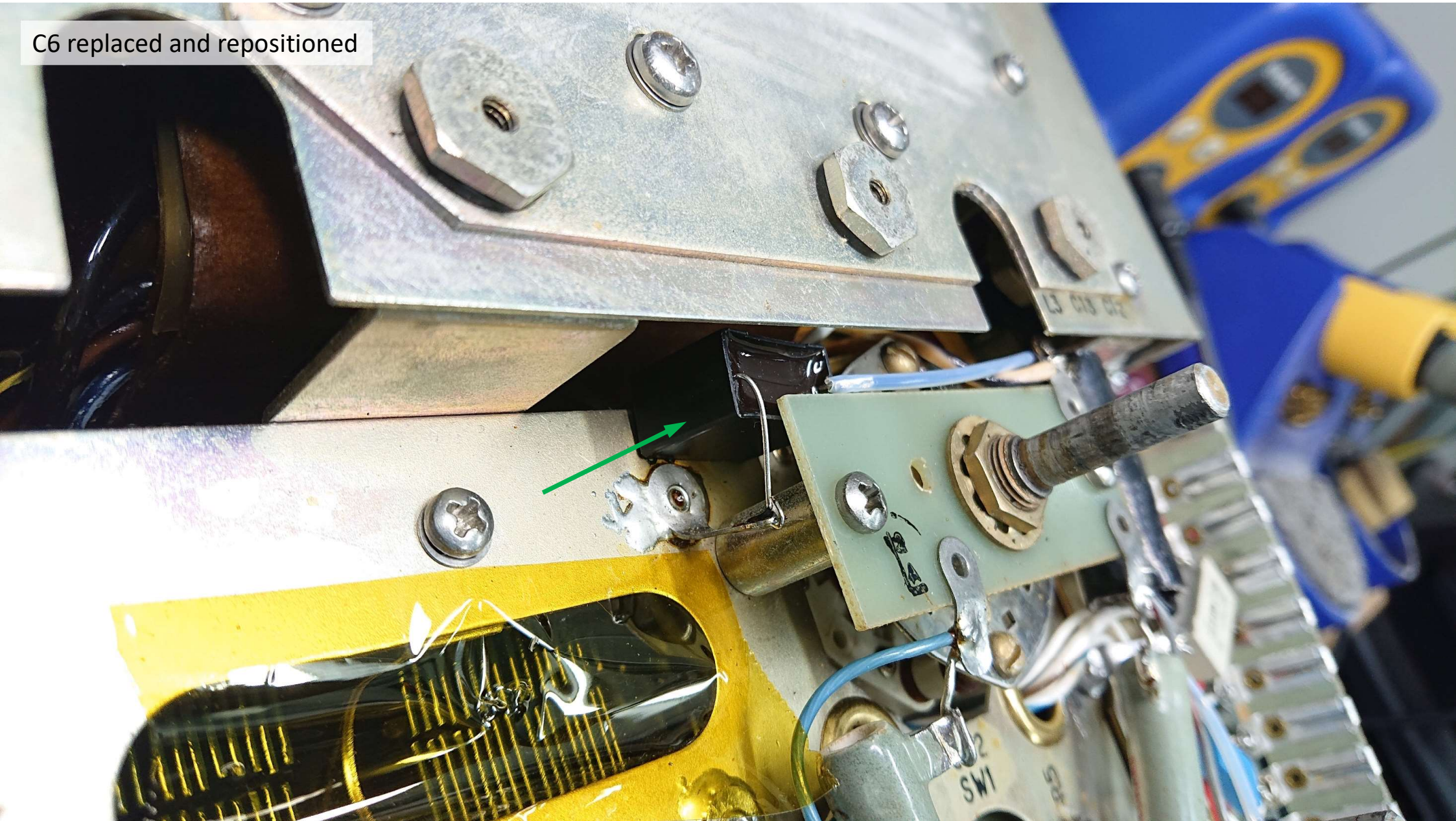


C1/C2 Replaced



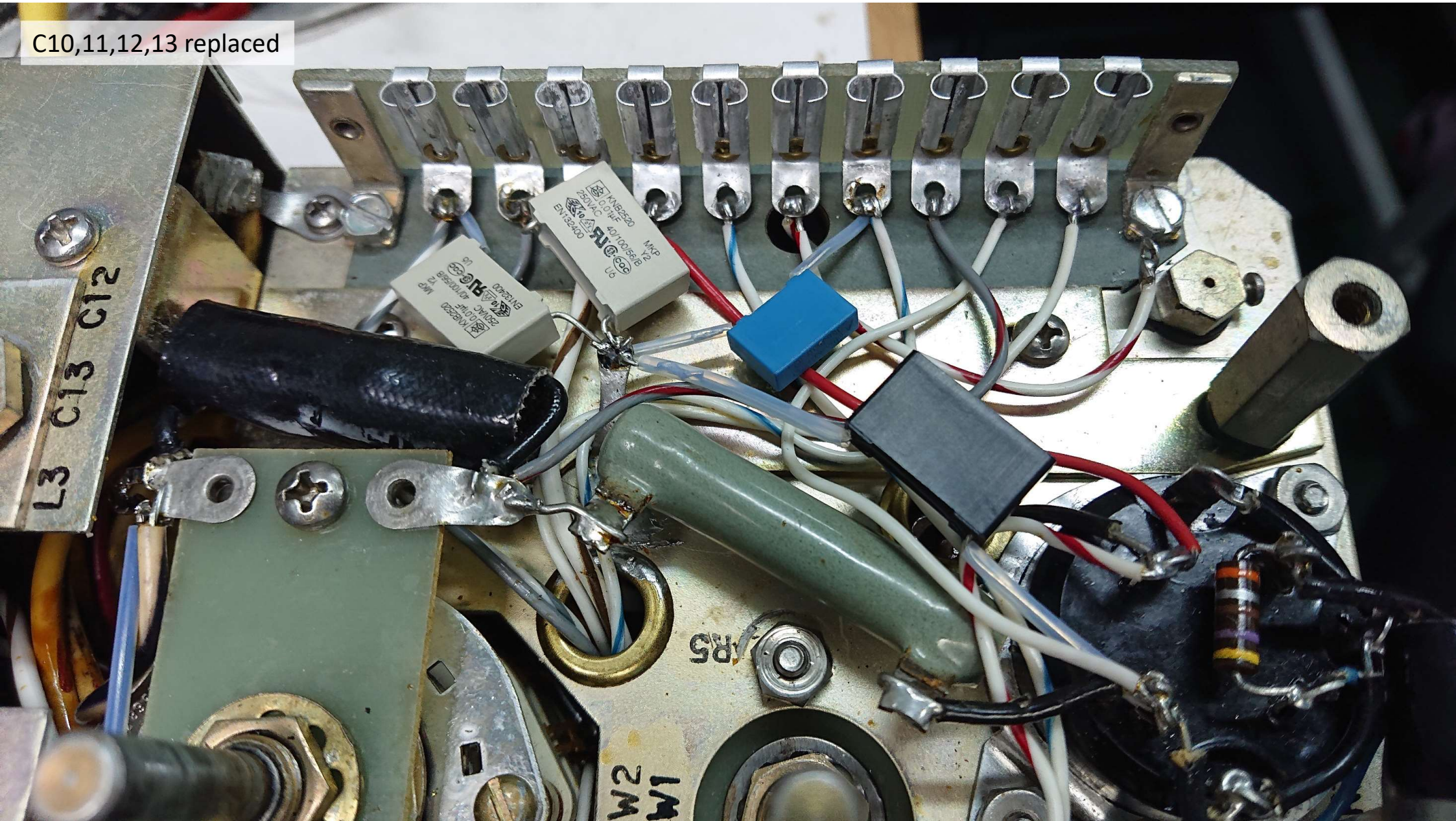


C6 replaced and repositioned



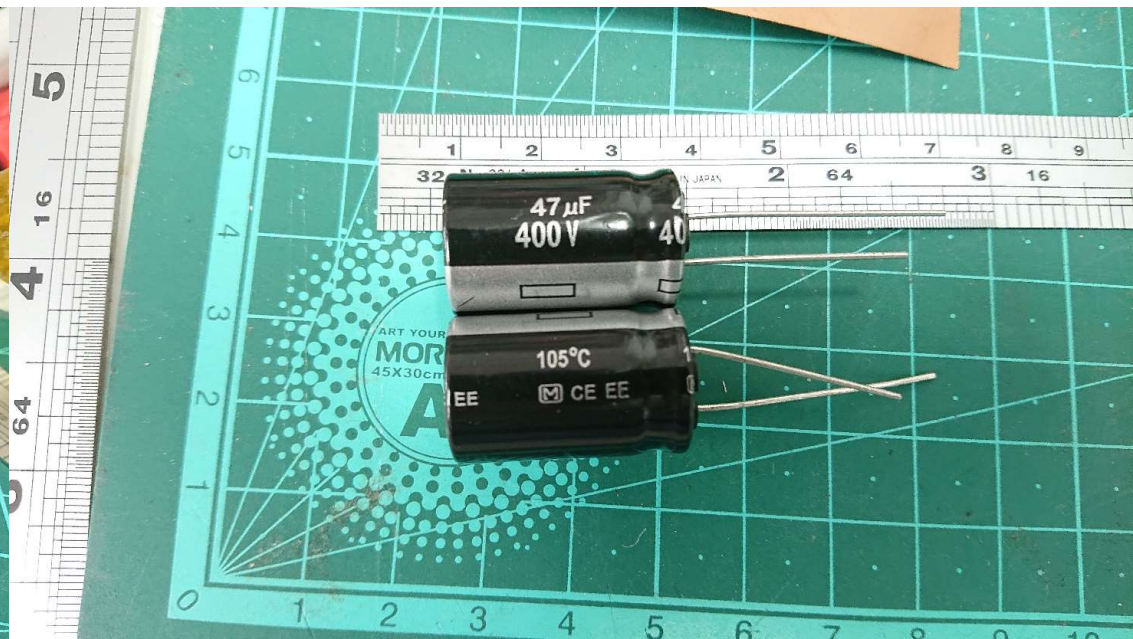


C10,11,12,13 replaced





Refilling C4/C5/C7





C4/C5/C7 refilled, re-sealed



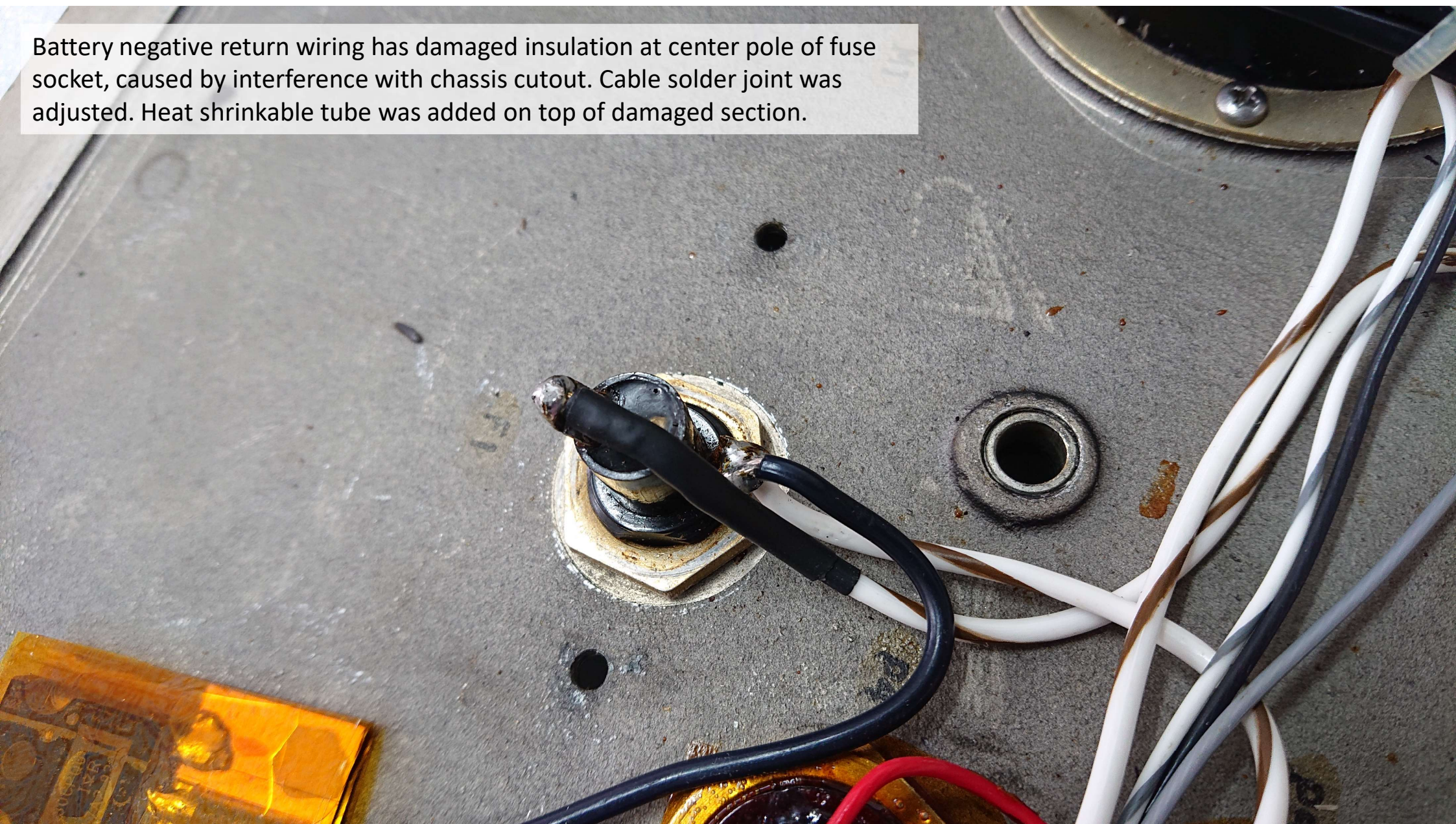


C4/C5/C7 installation C4 housing has high voltage DC potential, must be insulated  
C5,C7 housing too close to wafer switch, also need insulation  
New C8,C9 can be seen at two corners, size much smaller than old component





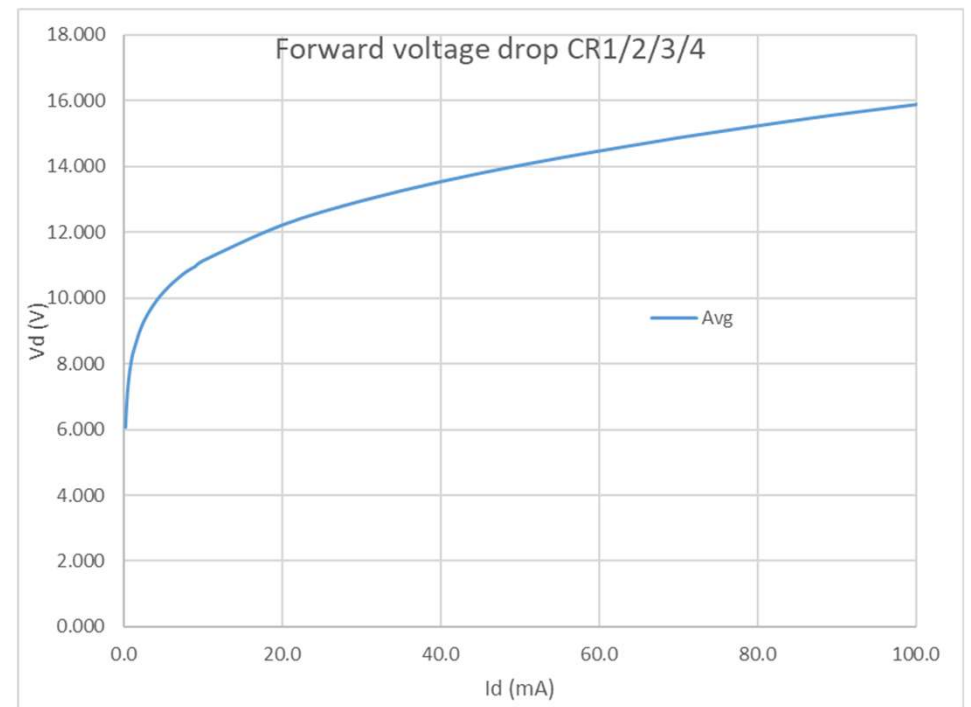
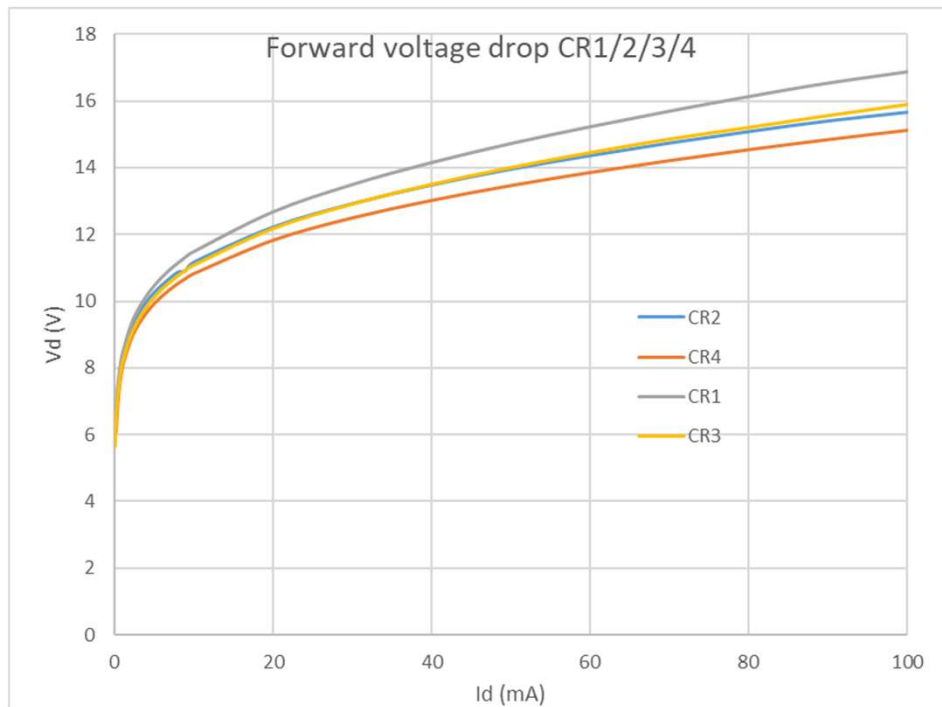
Battery negative return wiring has damaged insulation at center pole of fuse socket, caused by interference with chassis cutout. Cable solder joint was adjusted. Heat shrinkable tube was added on top of damaged section.





### High voltage Selenium rectifier characteristic

- Diode voltage drop 6V (130uA), 15.8V(100mA) total 16 stacks in series
- Single plate voltage drop 0.99V(100mA)
- Dynamic resistance 45.6Ω (20mA to 100mA)

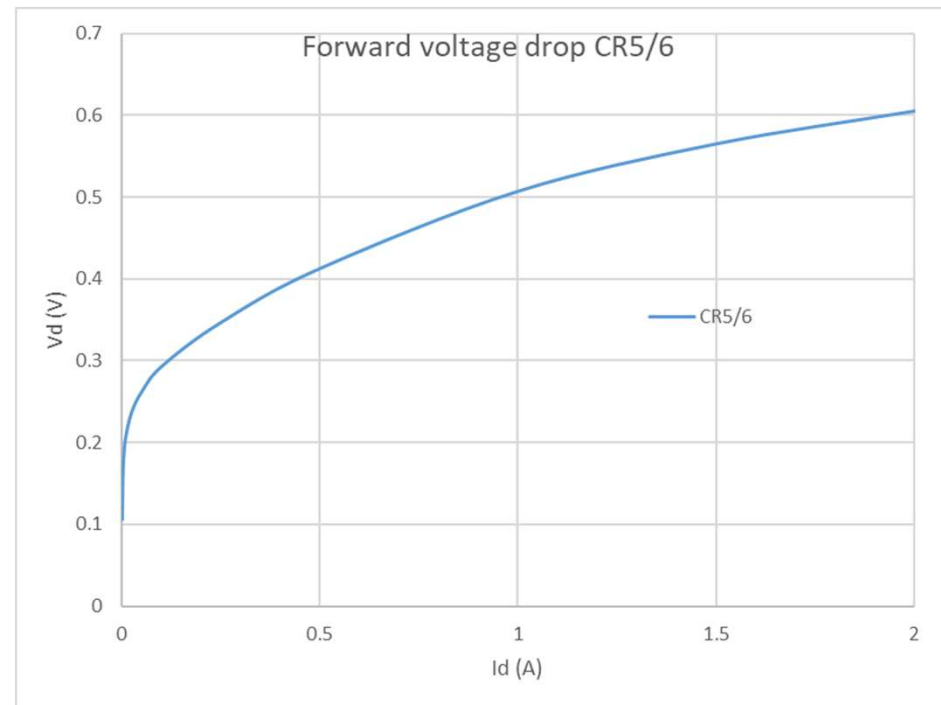


### Replacing rectifier with common Silicon device such as 1N4007

- Requires series resistance, starts with original dynamic resistance (45Ω) as starting point of adjustment
- Apply 50% derating rule for this resistor (2x of 0.45W)
- Expect increase in output voltage at open-circuit

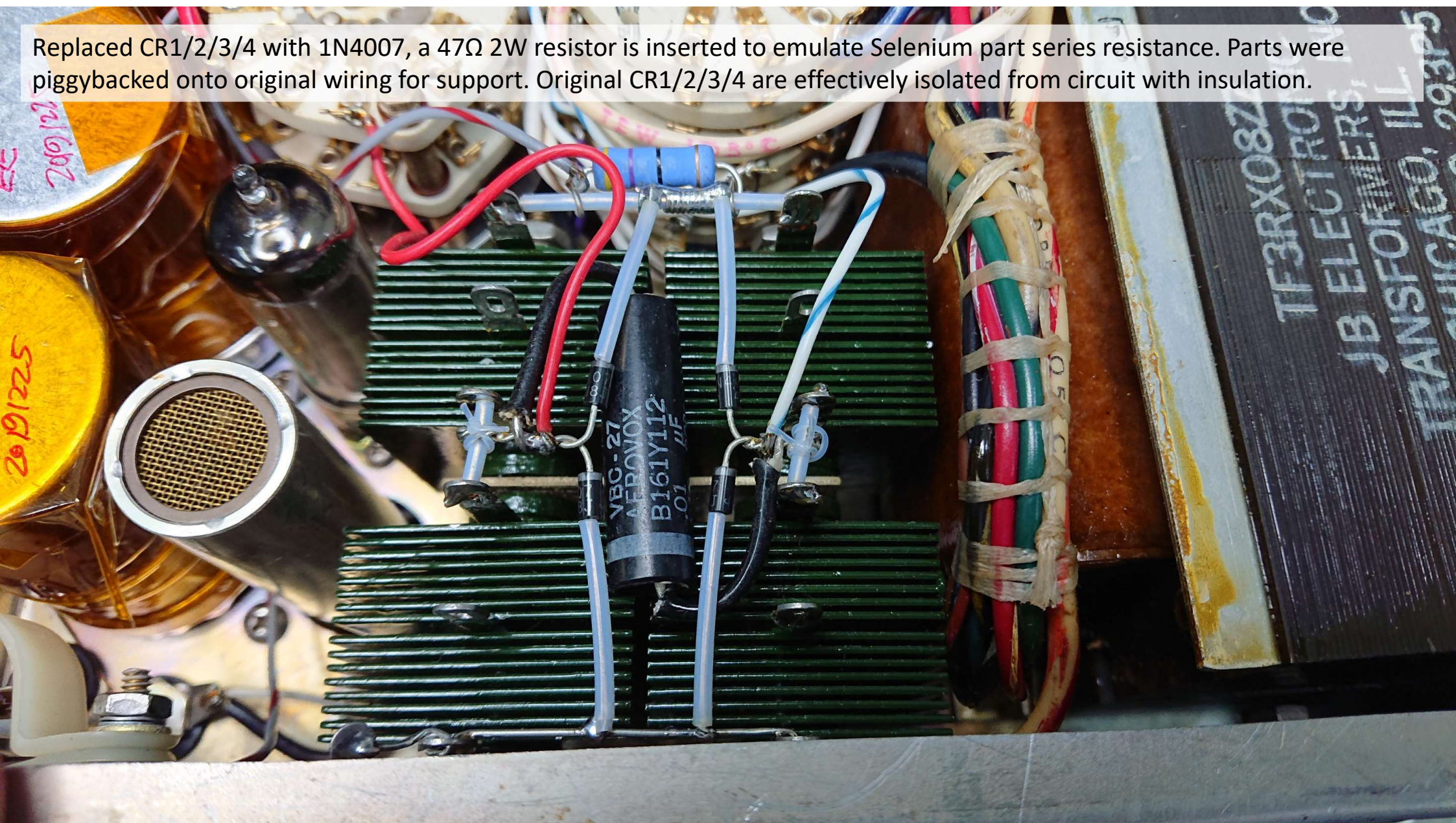
### Low voltage Selenium rectifier characteristic, battery charging section

- Diode voltage drop 0.1V (360uA), 0.6V(2A) 1 stacks
- Dynamic resistance 0.128Ω (0.5A to 2A)



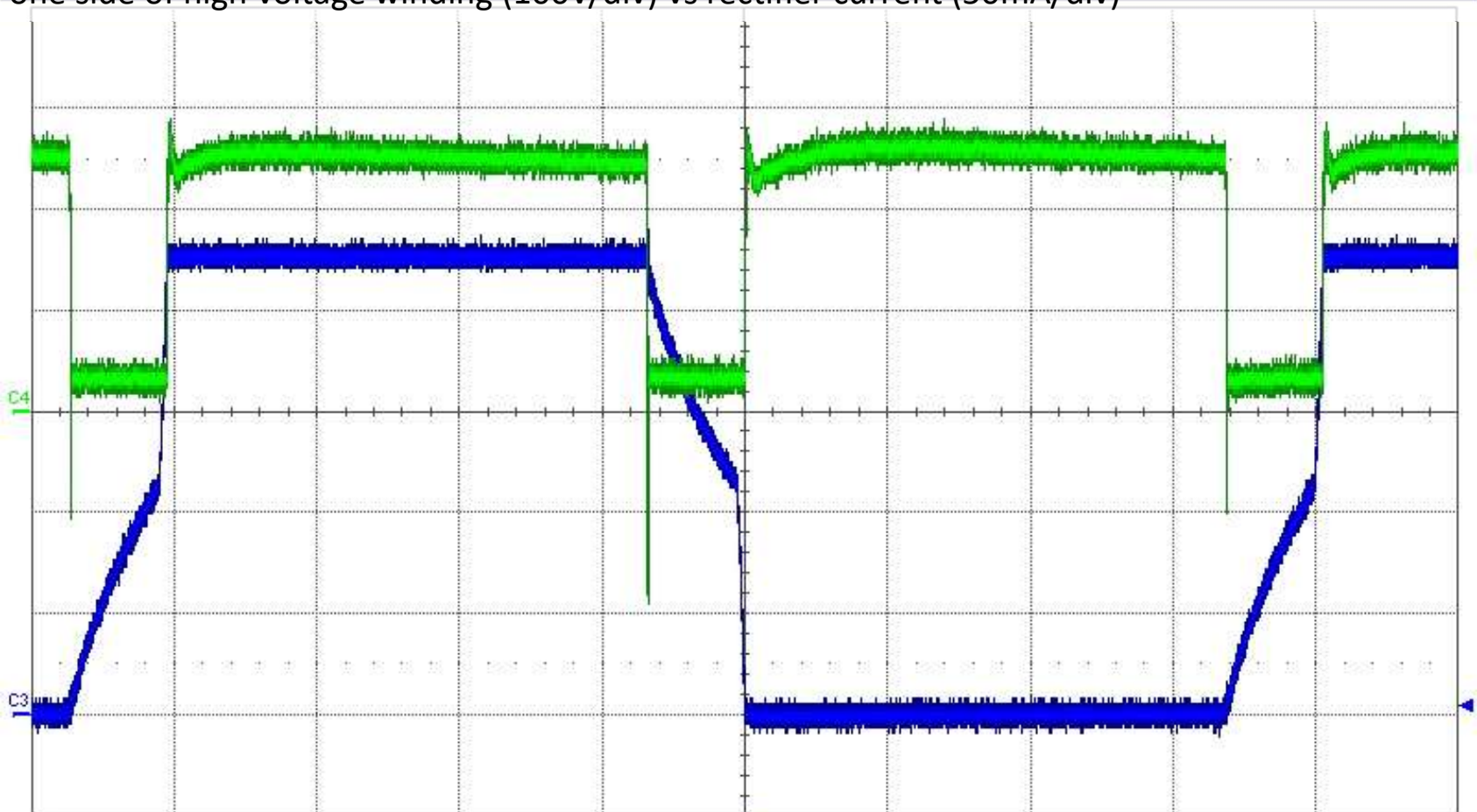


Replaced CR1/2/3/4 with 1N4007, a 47 $\Omega$  2W resistor is inserted to emulate Selenium part series resistance. Parts were piggybacked onto original wiring for support. Original CR1/2/3/4 are effectively isolated from circuit with insulation.





Waveform on one side of high voltage winding (100V/div) vs rectifier current (50mA/div)



|                |              |        |        |             |        |        |
|----------------|--------------|--------|--------|-------------|--------|--------|
| <b>Measure</b> | P1:freq(C1)  | P2:--- | P3:--- | P4:freq(C1) | P5:--- | P6:--- |
| value          | 445.14119 Hz |        |        |             |        |        |
| status         | .R.          |        |        |             |        |        |

|                 |                  |
|-----------------|------------------|
| <b>C3</b> 100mV | <b>C4</b> BwL DC |
| 100 V/div       | 50.0 mA/div      |
| -300.0 V ofst   | 0.0 mA ofst      |

|               |                  |               |
|---------------|------------------|---------------|
| <b>LeCroy</b> | Timebase 0.00 ms | Trigger C3    |
|               | 1.00 ms/div      | Auto 8 V      |
|               | 100 kS           | 10 MS/s       |
|               |                  | Edge Negative |

12/30/2019 1:56:35 PM

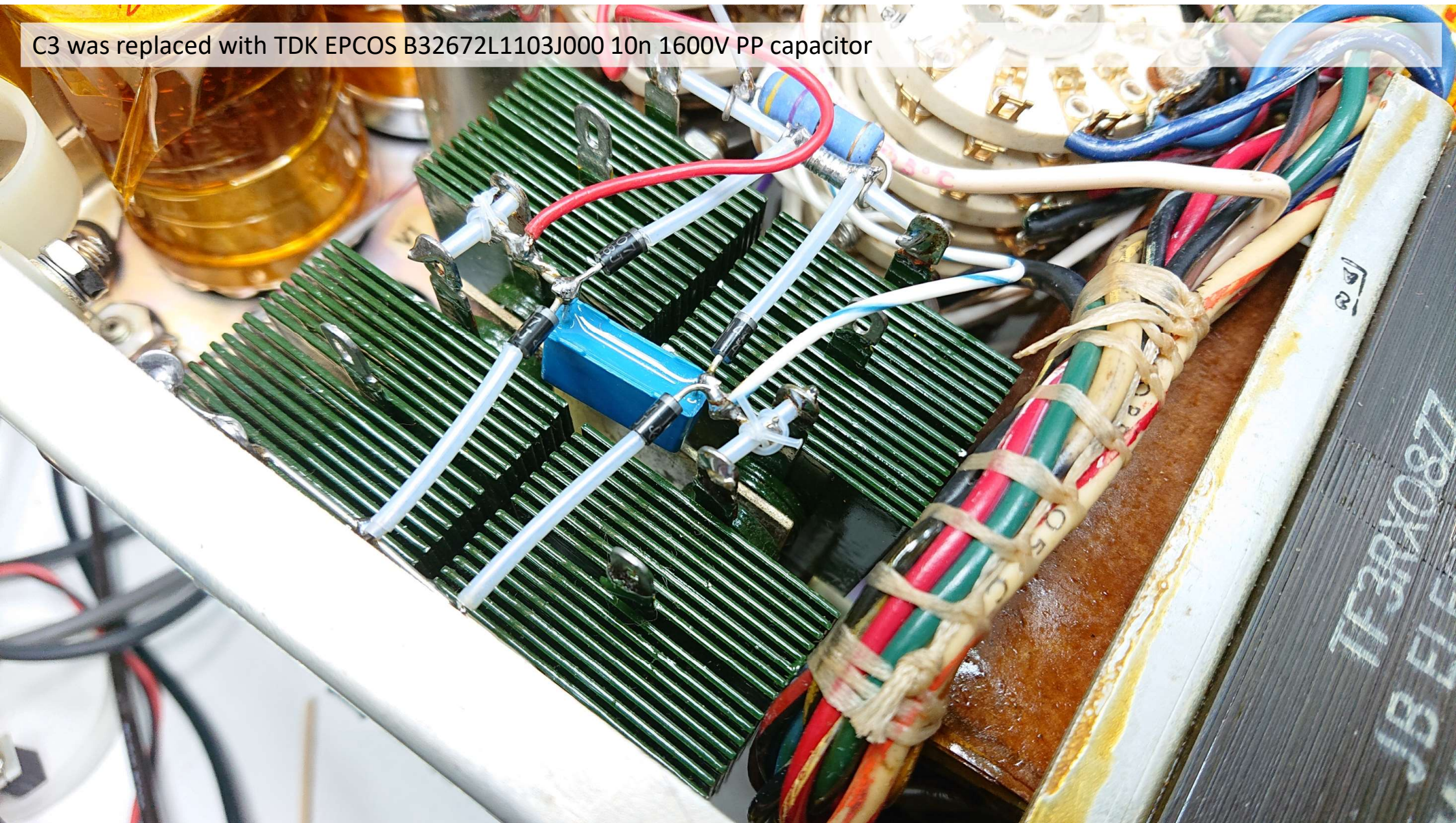


Added two series connected 1N4007 diode in parallel with CR7/8 as filament shunt regulator, new diodes provide ~1.6V voltage drop, original Selenium part not removed.





C3 was replaced with TDK EPCOS B32672L1103J000 10n 1600V PP capacitor





Fuse holder replaced with Littlefuse 03420006Z waterproof type 15mm hole size, original holder overheated causing fuse to blow under prolonged operation

